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14. ABSTRACT
Objectives. To describe the prevalence of symptoms of prostatitis; their distribution by race/ethnicity, age, socioeconomic status; and their association with urinary tract infections in the Boston Area Community Health survey (BACH). Methods. A racially and ethnically diverse community-based survey of adults aged 30-79 years in Boston, Massachusetts. The BACH survey has recruited adults in three racial/ethnic groups: Latino, African American, and White using a stratified cluster sample. The target sample size is equally distributed by gender, race/ethnicity, and age. This report gives estimates on a sample of 2301 men: 700 African American, 766 Latino, and 835 White. Symptoms of chronic prostatitis were derived from the pain and urinary symptom domains of the NIH Chronic Prostatitis Symptom Index. A score of ≥10 (moderate-to-severe) on the Index was defined as symptoms suggesting prostatitis. A $\chi 2$ statistic was computed to test the association of symptoms of prostatitis with categorical variables. Multiple logistic regression was used for the association of symptoms of prostatitis and multiple variables, and to calculate odds ratios and 95% confidence intervals (CIs). Results. The overall prevalence of symptoms of prostatitis is 4.3%. In a multiple logistic regression model, the number of urinary tract infections, particularly ≥2, was associated with chronic prostatitis symptoms. Persons with a history of 2 infections had 3 times the odds, and with ≥3 infections had 7.6 times the odds, to have current symptoms of chronic prostatitis (P=.0006). Conclusions. There is a strong association between current symptoms of chronic prostatitis and a history of urinary tract infections, particularly multiple infections. Further study is needed to determine whether prevention of recurrent infections can reduce the risk of chronic prostatitis.

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INTRODUCTION

Chronic prostatitis is a common urologic problem that impairs quality of life in men, and is difficult to treat.[1–3] There is scant evidence about potential risk factors for the development of chronic prostatitis symptoms, and particularly whether there are risk factors that can be modified.[4–5] Further identification and characterization of important risk factors for chronic prostatitis symptoms could lead to the development of risk reduction strategies.

The National Institutes of Health (NIH) classifies prostatitis syndromes as acute bacterial, chronic bacterial, chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS), and asymptomatic inflammatory prostatitis.[6] The most common syndrome is CP/CPPS, which is characterized by persistent discomfort or pain in the pelvic area. The cause of CP/CPPS is unknown; few studies have explored its risk factors, and treatment with antimicrobial agents and alpha-blockers has not shown significant improvement in symptoms or quality of life.[7–8]

The objective of this report is to describe the prevalence of symptoms of chronic prostatitis; their distribution by race/ethnicity, age, and socioeconomic status (SES); and their association with a history of urinary tract infections (UTIs).

BODY

The Boston Area Community Health (BACH) survey is designed to estimate the prevalence of symptoms of urological disorders in a multi-ethnic community-based sample of adults aged 30-79 years. The BACH survey has recruited 5506 adults (men and women) in three racial/ethnic groups: Latino, African American, and White, using a stratified cluster sample. This report is based on the 2301 men included in the study: 700 African American, 766 Latino, and 835 White.

Overall Design

The Boston Area Community Health (BACH) study is a population-based, random sample epidemiologic survey of a broad range of urologic symptoms. The research design had as its goal equal numbers of subjects (n=250) in each of 24 design cells, defined by age (30-39, 40-49, 50-59, 60-79 years), gender, and race/ethnicity (African American (black), Latino and Caucasian (White). The BACH multi-stage, stratified cluster sample (n=5506) was recruited from April 2002 through June 2005.

Stratified, Two-Stage Cluster Sample

The city of Boston was divided into 12 strata: four geographic areas by three levels of minority density. The geographic areas were formed by grouping Boston's planning districts. The levels of minority density were low density minority (primarily Caucasian), high density African-American (at least 25 percent of the residents were African-American), and high density Latino (at least 30 percent of the residents were Latino). Census blocks were randomly sampled from 4266 blocks in the city of Boston by stratum

such that approximately 10% of the low density minority blocks, 15% of the high density African American blocks, and 75% of the high density Latino blocks were selected.

Sampling proceeded in five batches, each a random sub-sample (or "mini-version") of the overall BACH study.[9] Households from selected census blocks were identified using a current Boston Resident List which had been geo-coded with census tract and block information for each individual. Telephone numbers were obtained from a telephone matching service for approximately half of the selected individuals. One individual (per household) was designated as the primary contact person with preference given to a person with a telephone number. Introductory letters were mailed to the selected households. These letters requested a contact telephone number if not already available (47.5% of the households). Households were screened either by telephone or by a field visit (in the absence of telephone number or if unable to reach the household by telephone). Screening was completed for 36.0% of the selected households, 30.0% of the households refused screening, and 34.0% of the households could not be contacted after at least 16 attempts to reach them by mail, telephone, or field visit.

Individuals from the selected census blocks were chosen according to modifiable eligibility rules to achieve our goal of approximately equal numbers of African-American, White, and Latino respondents in four age categories: 30-39, 40-49, 50-59, and 60-79 by gender. Eligibility rules varied by batch and were randomly assigned to selected households based on household demographics at the start of each batch. BACH inclusion criteria included: African-American, White, or Latino, age 30-79, eligible according to household's eligibility rule, competent to sign informed consent, and able to

speak English or Spanish well enough to complete the survey. In total we recruited 2301 men and 3205 women, 1770 blacks, 1877 Latino, and 1859 Whites. Interviews were completed with 63.3 percent of the screener identified eligible individuals from the selected households.

Because of design requirements, the BACH subjects had unequal probabilities of selection into the study. In order for analyses to be representative of the city of Boston, it was necessary to weight observations inversely proportional to their probability of selection into the study.[10-11] Weights were further post-stratified to the population of Boston according to the 2000 Census.

Data Collection

Data were obtained during a 2-hour, in-person interview, conducted by a well-trained (bi-lingual) phlebotomist/interviewer, generally in the subject's home.[12] Following written informed consent (all protocols and informed consent procedures were approved by NERI's Institutional Review Board), a venous blood sample (20 ml) and anthropometric measurements (blood pressure, height and weight) were obtained, along with information on medical and reproductive history, major co-morbidities, prescription and over-the-counter medications, lifestyles, psychosocial factors, medical care utilization and detailed self-reported major symptoms of seven different urogynecologic conditions (urinary incontinence, benign prostatic hyperplasia, interstitial cystitis/chronic pelvic pain, prostatitis, hypogonadism, erectile dysfunction, and female sexual dysfunction). Wherever possible, the questions and scales employed on BACH were selected from published instruments with documented metric properties. To ensure acquisition of the

highest quality data, all staff were trained, certified, monitored and regularly retrained in all procedures and protocols. A minimum of 10% double data entry helped ensure accurate data computerization. Regular reports from NERI's electronic data capture ADEPT software closely monitored all aspects of data completeness and quality.

Variables of Interest

Symptoms of prostatitis were derived from the pain and urinary symptom domains of the NIH Chronic Prostatitis Symptom Index (NIH CPSI).[13] A respondent with a symptom scale score of 10 or greater (moderate to severe) on the Index was defined as having symptoms of prostatitis.[13] Respondent's socioeconomic status (SES) was defined by the Green method which combines level of education and income.[14] Quality of life was measured by the SF-12 and converted to a physical and mental health component scores.[15] Alcohol use was derived from self-reported beer, wine, and hard liquor consumption, and categorized as none, less than 1, 1-3, and 3+ drinks per day. In the baseline questionnaire, participants were asked: "Have you ever been told by your health care provider that you had a bladder infection (urinary tract infection or cystitis) or kidney infection (pyelonephritis)?" If they answered "yes," they were also asked: "How many times were you diagnosed with a bladder infection (urinary tract infections or cystitis) in your lifetime?"

Statistical Analyses

Multiple imputation (MI) was used to impute missing values using the MI procedure in SAS version 9.1(SAS Institute Inc, Cary, NC).[16-18] Statistical analyses taking into account the complex survey design using sampling weights were done using

SUDAAN version 9.0.1.[19] The association of symptoms of prostatitis and categorical variables was measured by a chi-square statistic. Analysis of variance was used to measure the association of symptoms of prostatitis and continuous variables. A multiple logistic regression looked at the overall association of symptoms of prostatitis and multiple covariates, and to calculate the odds ratios (OR) and 95% confidence intervals (CIs).

Covariates (included in Table 1 and 2) were entered as categorical variables with the exception of socioeconomic status, physical health component score and the mental health component score which were entered as continuous variables. Keeping age group and race/ethnicity in the model, covariates were removed from the model using backwards elimination if $p > 0.1$ to yield a parsimonious model.

KEY RESEARCH ACCOMPLISHMENTS

The overall prevalence of symptom of chronic prostatitis (defined as moderate to severe on the NIH CPSI) was 4.3% with a standard error of 0.69%. Table 1 gives bivariate associations with categorical variables and Table 2 with continuous variables. In bivariate analyses, symptoms of prostatitis were 1.5% in those 30-39 years old, 3.8% in those 40-49 years old, 7.2% in those 50-59 years old, and 7.5% in those 60-79 years old, p=.0155. Symptoms of prostatitis were seen in 4.2% of the African Americans, 5.5% of the Latinos, and 4.1% of the Whites (p=.6167). Symptoms of prostatitis were higher for respondents of low SES (6.6%), than of middle (4.0%) or higher SES (2.8%), p=.0560. Thirteen percent of respondents with a history of prostate cancer had symptoms of prostatitis compared to four percent of those without a history of prostate cancer, p=.1157. Six percent of men with a history of a sexually transmitted disease had symptoms of prostatitis compared to 3.8 percent of those without a history of a sexually transmitted disease, p=.0973. Symptoms of prostatitis were seen in 3.19% of those without a history of urinary tract infections (UTIs) compared to 8.18% of those with 1 UTI, 12.48% of those with 2 UTIs and 32.69% of those with 3 or more UTIs, p=.0105.

REPORTABLE OUTCOMES

In a multiple logistic regression model, the number of UTIs in a patient's history was associated with symptoms of prostatitis, Table 3. Men with 2 UTIs had three-fold higher odds of having symptoms of prostatitis and those with 3 or more UTIs had almost eight-fold higher odds of having symptoms of prostatitis compared to those without a history of UTI. In addition, increasing age by decade was associated with increased chronic prostatitis symptoms, p=.0540. Symptoms of prostatitis increased with increased number

of health care provider visits in the last year and decreased with an increasing mental health component score after adjusting for age, race/ethnicity, alcohol use, and number of UTIs.

CONCLUSIONS

This study from the BACH survey, one of few racially and ethnically diverse community-based US samples to examine urological symptoms and diseases, found a strong association between current symptoms of chronic prostatitis and a self-reported history of UTIs. This association is biologically plausible because the mechanisms of prostatitis are believed to include ascension of urethral microbes or reflux of urine from the bladder into the prostate, with subsequent infection and or inflammation of the prostate.[20] This study may be the first to demonstrate a clear relationship between increasing number of UTIs and increasing incidence of chronic prostatitis symptoms.

Prior studies have shown that the lack of circumcision increases the risk of UTIs in men, along with unprotected sexual intercourse, benign prostatic hyperplasia, renal stones, increasing age, and urethral instrumentation.[21–26] In contrast to women, very little is known about UTIs in men,[27–28] partly due to the low incidence UTIs in men compared with women.[29] In our BACH population, only 9.4% of men had a history of one or more UTIs. Current research on UTIs in men show that men and women have similar infecting bacterial species, host predispositions and treatment results.[30] One important and obvious difference between men and women is the presence of a prostate gland and the poor antimicrobial penetrance into this gland. Total annual health care expenditures are higher

for men than for women with UTI ($5,544 vs. $5,407) and mean time lost from work due to cystitis is also slightly higher for men (10.5 vs. 4.8 hours).[31]

We used the NIH CPSI, a validated symptom index that differentiates men with CP/CPPS. The questionnaire has proven to have a high degree of internal consistency and reliability when self-administrated in clinical practice for patients with chronic prostatitis. The NIH CPSI total score has been accepted as a reliable outcome measure for prostatitis treatment in primary and secondary care patients.[32] Ejaculatory pain and peritoneal pain, which are part of this index, are very sensitive measures of CP/CPPS.[33] The overall prevalence of symptoms, in our study, of prostatitis was 4.3%, which is within the range of overall prevalence of prostatitis previously estimated at between 2% and 16%.[2, 34-37] The diagnosis of prostatitis, similar to other urologic diagnoses, is largely symptom driven. Whether we should continue to use these index criteria for research purposes and in clinical care is unknown.

History of prostate cancer was not significantly associated with a history of chronic prostatitis symptoms in our multivariate model, although it is unknown whether the onset of prostatitis symptoms preceded or followed the cancer diagnosis. Associations between prostate cancer and prostatitis have been reported, but its exact relationship has not been well characterized. It is clear that lower urinary tract symptoms or symptoms of prostatitis may prompt prostate-specific antigen testing and digital rectal examination, which increases the likelihood of a prostate cancer diagnosis. On the other hand, data increasingly suggest that inflammation of the prostate may promote carcinogenesis, similar to the association of inflammation with other cancers.[38–40]

Symptoms of prostatitis increased with increased number of health care provider visits in the last year and increased with a decreasing mental health component score. These findings suggest that patients with more severe symptoms of chronic prostatitis tend to see doctors more often and patients with lower mental health scores may tend to have more symptoms of chronic prostatitis possibly due to their increased likelihood of social isolation or prostatitis symptoms may decrease mental health.

Our study has several important limitations. Because of the cross-sectional nature of the data, our findings do not suggest causality, but do call for additional research into the relation of a history of UTIs and chronic prostatitis. Moreover, it is possible that misclassification may have occurred if physicians labeled early symptoms of prostatitis as UTIs. The reliability of self-report (e.g. questionnaires) of prostatitis and UTIs is largely unknown, since prostatitis, in particular, is often a clinical diagnosis of exclusion and is difficult to definitively diagnose. Alternatively, the strengths of the study lie in its large sample sizes of different racial and ethnic groups and the random selection of study participants, as well as the strong association of chronic prostatitis symptoms in men with a self-reported history of an increasing number of UTIs. A recently published case-control study examining risk factors for CP/CPPS also found that men with CP/CPPS were significantly more likely to have a history of UTI.[42]

In conclusion, these results show that an increasing number of UTIs is positively associated with subsequent symptoms of chronic prostatitis. Reduction of recurrent UTIs may decrease the development of chronic prostatitis. Our study was not designed to demonstrate modification of risk factors for symptoms of chronic prostatitis. Nevertheless, it is prudent to recommend that patients take precautions, such as using

protective barriers during sexual intercourse and reduction of urethral catheterization, to reduce exposure to microbes that can cause infections. Further study is needed to determine if prevention of recurrent UTIs can reduce the risk of chronic prostatitis.

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Table 1. Symptoms of Prostatitis by Selected Characteristics of the 2301 Men in the BACH Study (All numbers are weighted to reflect population of Boston with the exception of sample size N*)

			Symptoms of Prostatitis		
	Sample Size N*	Sample Percent	Percent	S.E.	p
Age Group					
30-39	614	37.20	1.54	0.62	.0155
40-49	661	25.82	3.82	1.20	
50-59	509	17.82	7.21	1.72	
60-79	517	19.16	7.51	2.25	
Race / Ethnicity					
African American	700	25.05	4.21	0.88	.6167
Latino	766	13.02	5.46	1.19	
White	835	61.93	4.06	1.06	
Prostate Cancer					
Yes	50	1.86	13.07	5.83	.1157
No	2251	98.14	4.12	0.68	
Sexually Transmitted Disease					
Chlamydia					
Yes	119	4.95	5.22	2.11	.6587
No	2182	95.05	4.23	0.72	
Genital Herpes					
Yes	56	2.74	6.83	3.54	.4608
No	2245	97.26	4.21	0.69	
Syphilis					
Yes	70	2.70	8.05	5.19	.4754
No	2231	97.30	4.18	0.70	
Gonorrhea					
Yes	325	11.05	7.10	1.88	.1247
No	1976	88.95	3.93	0.74	
HPV or genital warts					
Yes	58	3.79	6.90	3.28	.4144
No	2243	96.21	4.18	0.70	
HIV or AIDS					
Yes	38	1.45	9.93	4.53	.2166
No	2263	98.55	4.20	0.69	
Any STD					
Yes	480	18.52	6.30	1.33	.0973
No	1821	81.48	3.82	0.76	

Urinary Tract Infections					
0	2083	91.01	3.19	0.58	.0105
1	106	4.59	8.18	3.32	
2	58	2.14	12.48	4.79	
3	53	2.26	32.69	9.43	
Kidney Infection					
Yes	76	2.54	13.51	5.81	.0891
No	2225	97.46	4.04	0.70	
Vasectomy					
Yes	108	7.10	3.70	2.97	.8326
No	2193	92.90	4.33	0.67	
Family History of Prostate Cancer					
Yes	366	13.82	6.61	2.12	.2612
No	1935	86.18	3.91	0.77	
Medication Use (in past month)					
Non-steroid anti-inflammatories					
Yes	97	5.25	14.80	6.61	.1369
No	2204	94.75	3.70	0.59	
Steroid anti-inflammatories					
Yes	25	1.00	7.10	4.25	.6587
No	2276	99.00	4.25	0.68	
Male hormones					
Yes	19	0.96	22.29	13.32	.2076
No	2282	99.04	4.11	0.67	
Number of Health Care Provider Visits in Last Year					
0	271	9.80	0.69	0.30	.0009
1-4	1129	49.17	2.14	0.53	
5-9	404	18.21	3.70	1.30	
10+	497	22.83	10.91	2.44	
Smoking					
Never smoked	963	45.14	3.74	0.91	.5355
Former smoker	663	28.71	3.86	1.08	
Current smoker	675	26.16	5.68	1.54	
Socioeconomic status					
Low	962	23.82	6.55	1.27	.0560
Middle	961	49.50	3.99	0.98	

High	378	26.68	2.79	0.92	
Alcohol use (drinks per day)					
None	800	27.48	6.55	1.53	.0354
<1	805	38.61	2.34	0.58	
1-3	444	24.35	3.67	1.35	
3+	252	9.56	7.15	2.49	
Sexual Orientation					
heterosexual	1991	84.74	4.13	0.72	.9372
homosexual	207	11.88	5.15	2.35	
bisexual	44	1.82	6.07	3.22	
asexual / other	59	1.56	3.92	5.70	

* un-weighted

Table 2 Association of Continuous Variables and Symptoms of Prostatitis – Weighted to Reflect Population of Boston

	Symptoms of Prostatitis				
	Yes		No		
	mean	s.e.	mean	s.e.	p
SF-12 Quality of Life					
Physical Health Component Score	42.33	1.97	50.62	0.32	.0001
Mental Health Component Score	42.26	1.61	50.74	0.36	<.0001
Number of Health Care Provider Visits in Last Year	14.35	2.25	7.57	0.49	.0047
Age, years	54.12	1.81	47.33	0.46	.0003
Number of Urinary Tract Infections	1.13	0.31	0.18	0.03	.0021
Socioeconomic Status	53.98	1.27	57.97	0.40	.0020

Table 3: Logistic Regression Model (Symptoms of Prostatitis)

	Odds Ratio		
	point estimate	95% Confidence Interval	p
Age Group			
30-39	0.24	0.07, 0.81	.0540
40-49	0.41	0.13, 1.26	
50-59	0.93	0.39, 2.22	
60-79	1.00	reference	
Race/Ethnicity			
African American	0.97	0.46, 2.06	.1932
Latino	1.91	0.78, 4.71	
White	1.00	reference	
Urinary Tract Infections			
0	1.00	reference	.0006
1	3.00	1.09, 8.24	
2	2.99	0.92, 9.73	
3+	7.64	2.93, 19.96	
Number of Health Care Provider Visits During Past Year			
0	0.12	0.04, 0.33	.0025
1-4	0.33	0.14, 0.80	
5-9	0.42	0.18, 0.94	
10+	1.00	reference	
Alcohol Use (Drinks per day)			
0	1.00	reference	.0881
< 1	0.49	0.23, 1.07	
1-3	1.15	0.41, 3.20	
3+	1.62	0.57, 4.62	
Mental Health Component Score	0.94	0.92, 0.97	.0001